Lightweight, High Strength Metals With Enhanced Radiation Shielding - Technology Advancing Partnerships Challenge (TAP)

Completed Technology Project (2014 - 2015)

Project Introduction

The Technology Advancing Partnership (TAP) Challenge will seek to foster innovation throughout the Center by allowing the KSC workforce to identify a specific technology idea that needs improvement and to then work with an external partner to develop that technology. This Challenge will enable competitive partnerships with outside entities that will increase the value by bringing leveraged resources. The selected proposal from the University of Florida will develop new lightweight technologies with radiation mitigation for spacecraft.

The alloy of interest will be magnesium-based, which will make it 70% lighter than steel and 65% of the density of aluminum, giving it a potential to decrease fuel consumption dramatically. Magnesium (Mg) has been approved by Federal and Joint Aviation standards and NASA standards state that it can be used in areas that are not prone to corrosion. Thus, the proposed applications include the skin or cladding within structural members or on non-oxidizing environments such as Mars. The Europe Commission is investigation the general use of Mg alloys for aerospace applications under the AEROMAG project, which considers the use of Mg as a breakthrough technology.

The objectives of the research are to 1) develop high strength Mg-based alloys doped with thermal radiation mitigation (neutron-absorbing) elements, 2) characterize their microstructure and mechanical properties, and 3) characterize their radiation shielding efficiency. This work will be carried out at the University of Florida which houses state-of-the-art radiation testing facilities and light metals foundry capability of designing, fabricating, and testing any light weight structural material. The proposed work leverages existing programs supported by the University of Florida, National Science Foundation, and the Department of Energy.

The results of this work are not only expected to elucidate fundamental radiation shielding mechanisms inherent to doped Mg alloys but also explore the opportunity to integrate Mg into non-critical members, thus potentially creating a new area of research and center of excellence for NASA Kennedy Space Center.

Anticipated Benefits

A major milestone for human exploration at Low Earth Orbit (LEO) and beyond Low Earth Orbit (b-LEO) is the mitigation of harmful secondary radiation to which astronauts are exposed. This technology would come up with a lightweight structural material that has the ability to mitigate neutron emission from secondary radiation, which would increase safety of the crew on the International Space Station (ISS).

The safety of the crew for deep space human exploration (i.e. Mars) is imperative, particularly for missions that can potentially last years. This

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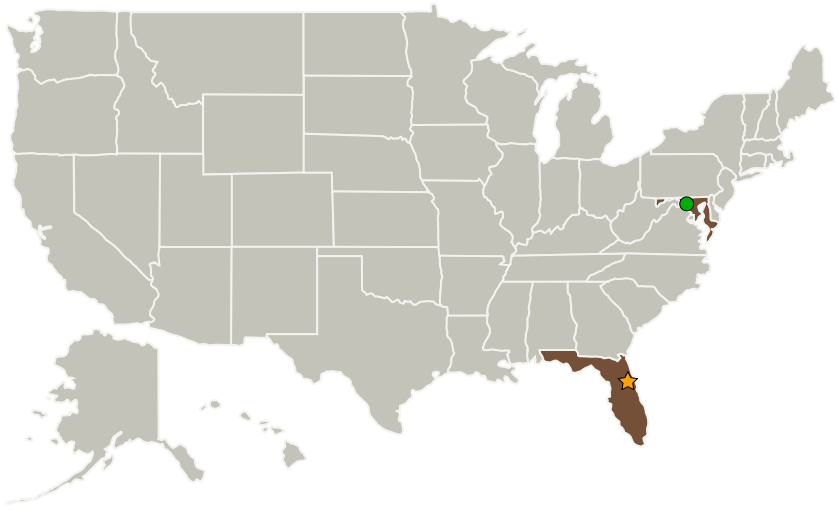
technology would mitigate some of the more harmful secondary radiation from galactic cosmic rays (GRCs) when compared to conventional metallic structural components.

Private companies who want to travel to Low Earth Orbit (LEO) or beyond Low Earth Orbit (b-LEO) have the same requirements to keep their crew protected from secondary radiation emitted by interaction of galactic cosmic rays on vehicle and habitat materials. The material being developed would increase crew safety to NASA as well as the commercial space industry.

Other federal agencies including the Department of Energy (DoE) and Defense Advanced Research Projects Agency (**DARPA**) would benefit from this technology for radiation shielding.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Barbara L Brown

Project Manager:

Maria C Wright

Principal Investigator:

Maria C Wright

Co-Investigators:

Kelly A Jordan
Michele Manuel

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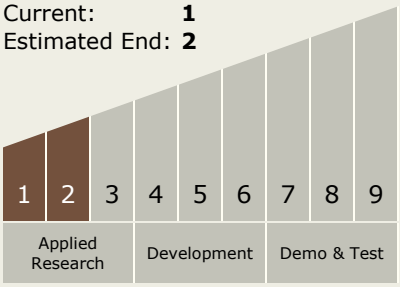
Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
University of Florida	Supporting Organization	Academia	Gainesville, Florida

Primary U.S. Work Locations	
Florida	Maryland

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **2**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.1 Lightweight Structural Materials